Applied Data Science Capstone Report

Opening A BBQ Restaurant in Kansas City

1. Introduction

One of the things that Kansas City is most well known for is their distinct barbecue style - a variety of different meats that are slow smoked and coated in a thick tomato based sauce. If you ask a Kansas City local what their favorite barbecue restaurant is, you are likely to hear a variety of answers. There are many different restaurants located around the metropolitan area, and each one has a slightly different take on the style than the others. However, as the Kansas City metropolitan area continues to grow, there will be additional opportunities for new BBQ restaurants to start up. The biggest challenges that a new BBQ restaurant would face is standing out within the Kansas City area, and a good location is one of the best ways to address this challenge. This report is an attempt to help future business developers decide where in Kansas City a new BBQ venue could be placed successfully.

The major factors we will use to determine the optimal location of a new BBQ restaurant are the following:

1. How many additional BBQ restaurants are within the region of Kansas City?

2. How many restaurants in total are already located within the region of Kansas City?

3. How many people live in this region of Kansas City?

Our ultimate goal is to find a location that is well populated, but that also isn't completely developed with too many restaurants and especially restaurants that would be a direct competitor with the new venue that is being planned.

By using data science techniques, we will analyze the neighborhoods of the Kansas City metropolitan area on the criteria given above. Then, based on these criteria, we will make some recommendations of potential locations that the new BBQ restaurant could be placed into, with the positives and negatives of each potential location considered.

2. Data

The Kansas City metropolitan area can be divided into Kansas City and a large collection of suburban areas that surround it. As we would like to place our new restaurant in a well populated area, according to the criteria given in the introduction, let's limit ourselves to towns in the Kansas City metro area with a population above

20,000 people. This leaves us with the following collection of towns, with given populations, as provided by the wikipedia page https://en.wikipedia.org/wiki/Kansas_City_metropolitan_area:

Name	Latitude	Longitude
Kansas City Missouri	39.100105	-94.578142
Kansas City Kansas	39.113456	-94.626497
Overland Park Kansas	38.974250	-94.685170
Olathe Kansas	38.883886	-94.818870
ndependence Missouri	39.092479	-94.413792
Lee's Summit Missouri	38.910716	-94.382130
Shawnee Kansas	39.041672	-94.720238
Blue Springs Missouri	39.017316	-94.282265
Lenexa Kansas	38.969746	-94.784584
Leavenworth Kansas	39.311326	-94.922759
Leawood Kansas	38.966673	-94.616901
Liberty Missouri	39.246479	-94.419079
Raytown Missouri	39.016843	-94.463047
Gladstone Missouri	39.221477	-94.571975
Grandview Missouri	38.889848	-94.531382
Belton Missouri	38.810810	-94.531350
Prarie Village, Kansas	38.989722	-94.636111
Gardner Kansas	38.810925	-94.927296
Raymore Missouri	38.810131	-94.467650

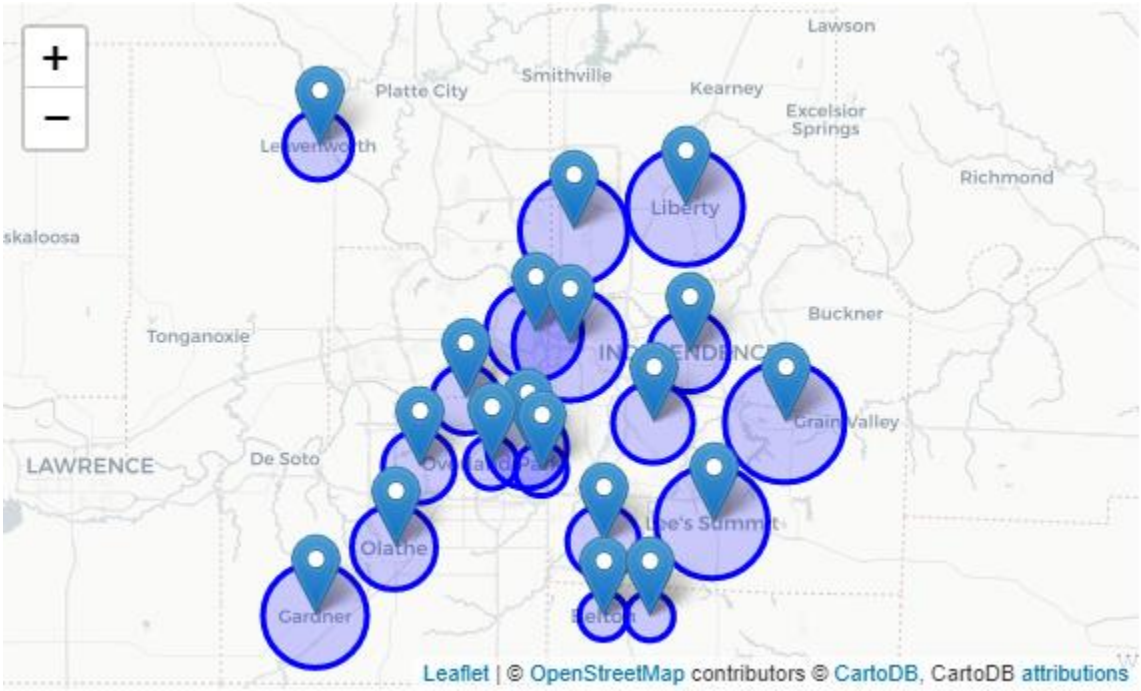
While there are numerous other municipalities within the Kansas City area, a majority of these municipalities are located within a 15 minute drive from one of the larger municipalities listed above. As a result, we will not consider them as large enough to warrant consideration for the location of a thriving new BBQ business within the Kansas City area.

In order to make a decision about which of the following municipalities would make good locations for a new BBQ restaurant, we collected and used the following information:

1. The geographic latitude and longitude coordinates for each of the cities listed above. These centers can be obtained by using the geopy package in Python, or additionally, through the Wikipedia pages for the municipalities, all of which are linked in the reference above.
2. A geographical boundary for each of the following cities. As each of the above municipalities have different sizes from one another, it will be important to provide a radius in which we want to search for other restaurants and in particular other BBQ restaurants that our new venue would have to compete against.
3. By applying the Foursquare API, we will collect a list of all restaurants, as well as those which are designated BBQ restaurants within the boundaries that are defined in the previous point.

After all of this data is collected, we can use it to determine which municipalities are the best fit for our new venue.

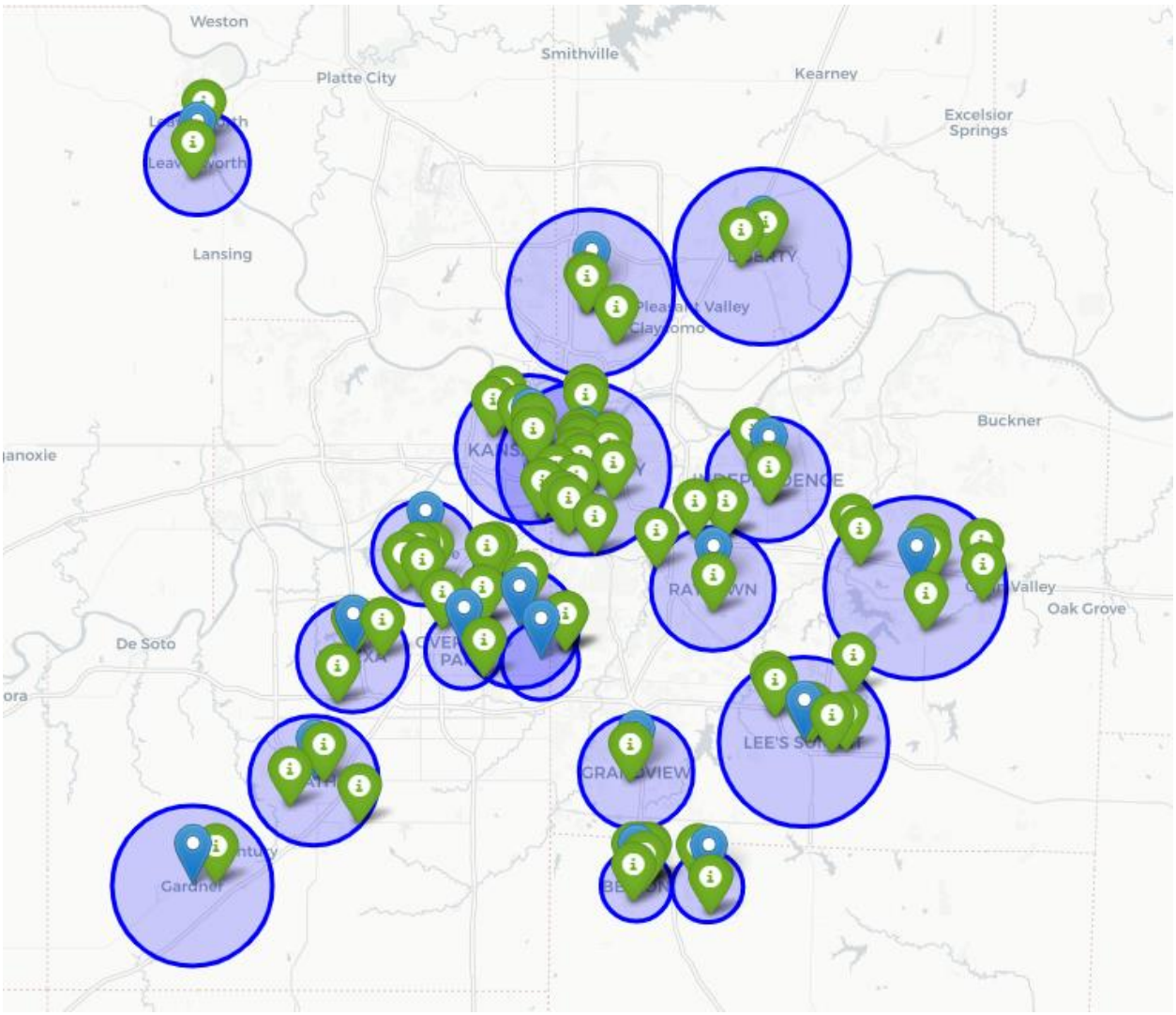
The data in points 1 and 2 were collected by using geopy in Python, then by computing the minimum distance between the centers of each of the locations, and dividing it by 2 to give a radius for each municipality. These radii were at minimum 1.5 miles, and adjusted manually in cases where the boundaries seemed too large (e.g., Leavenworth, which has no nearby centers). A map of these centers and their radii are provided below.



Finally, the data in point 3 was collected using Foursquare. A collection of the total number of restaurants in each municipality was found, along with a total of the number of BBQ restaurants in each municipality. This is collected in the table below, along with the total population for each of the municipalities.

Name	Latitude	Longitude	minDistance	minDistanceMeters	BBQCount	RestaurantCount	Population
Kansas City Missouri	39.100105	-94.578142	8.228269	13242.083018	19.0	100.0	488943
Kansas City Kansas	39.113456	-94.626497	7.065800	11371.274754	14.0	100.0	152938
Overland Park Kansas	38.974250	-94.685170	3.713225	5975.841168	3.0	100.0	191278
Olathe Kansas	38.883886	-94.818870	6.204160	9984.603159	3.0	100.0	137472
ndependence Missouri	39.092479	-94.413792	5.851633	9417.267530	3.0	98.0	117306
Lee's Summit Missouri	38.910716	-94.382130	8.172844	13152.884795	7.0	100.0	97290
Shawnee Kansas	39.041672	-94.720238	5.019238	8077.661186	4.0	81.0	65513
Blue Springs Missouri	39.017316	-94.282265	8.770909	14115.374769	7.0	100.0	54945
Lenexa Kansas	38.969746	-94.784584	5.362264	8629.705748	3.0	57.0	53553
Leavenworth Kansas	39.311326	-94.922759	5.000000	8046.700000	2.0	56.0	36210
Leawood Kansas	38.966673	-94.616901	3.713225	5975.841168	1.0	70.0	34659
Liberty Missouri	39.246479	-94.419079	8.382144	13489.718880	2.0	56.0	31507
Raytown Missouri	39.016843	-94.463047	5.851633	9417.267530	5.0	81.0	29211
Gladstone Missouri	39.221477	-94.571975	8.006209	12884.711790	3.0	100.0	27140
Grandview Missouri	38.889848	-94.531382	5.452052	8774.205713	1.0	46.0	25159
Belton Missouri	38.810810	-94.531350	3.438242	5533.300801	6.0	42.0	23480
Prarie Village, Kansas	38.989722	-94.636111	5.773958	9292.261480	5.0	100.0	22368
Gardner Kansas	38.810925	-94.927296	7.716028	12417.712749	1.0	31.0	21583
Raymore Missouri	38.810131	-94.467650	3.438242	5533.300801	2.0	31.0	21167

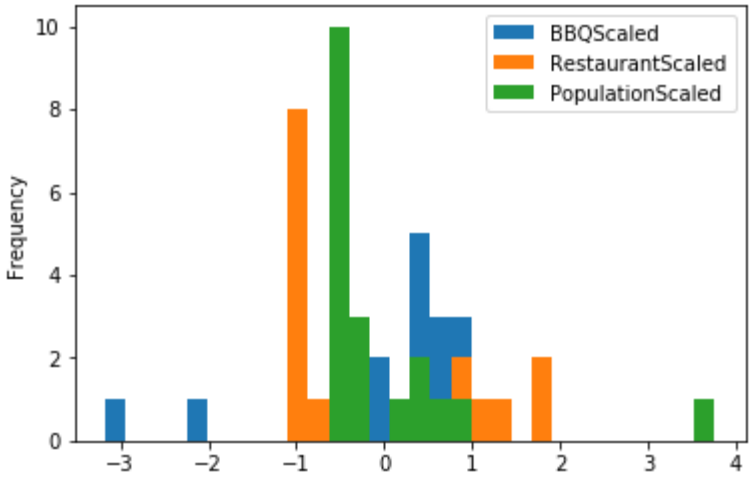
In addition, we plot all of the various BBQ restaurants around Kansas City in the following map.



3. Methodology

To analyze the data, we'll first focus on determining which municipalities we would consider for the possible location of our restaurant. To do so, we used the following weighting system, to make the decision concrete: suppose that 50% of our concern is being located in a district with too many BBQ restaurants, 10% of the concern is that the restaurant is located in a district with too many restaurants, and the final 40% of the concern is the restaurant be placed into a location with a high population.

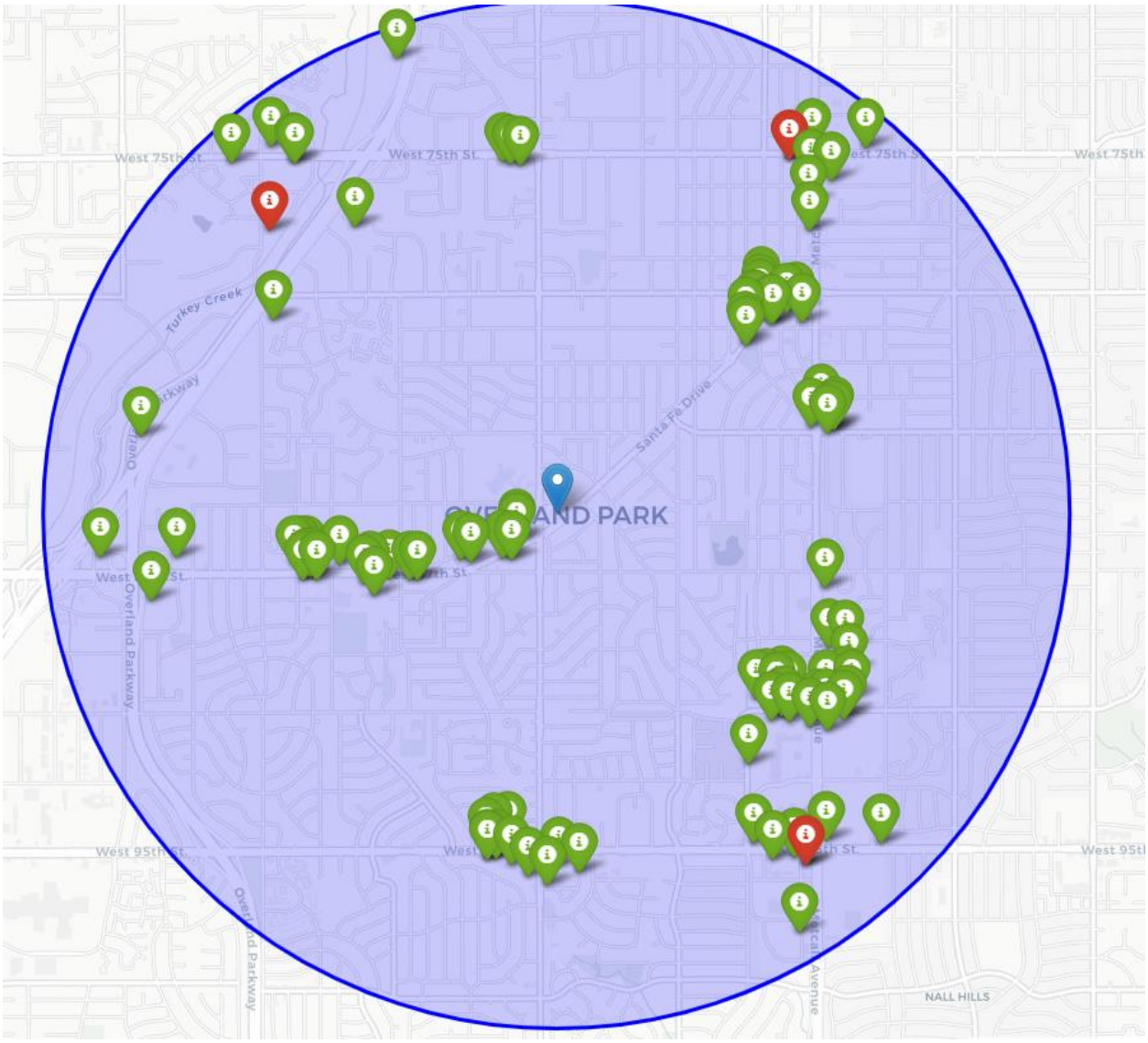
First, we standardized the population data, number of restaurants, and number of BBQ restaurants to a normal distribution. Then, to ensure that positive values corresponded to better scores, we transformed the number of restaurants and number of BBQ restaurants so that smaller numbers of each would correspond to higher scores. A histogram of the normalized values can be seen below.



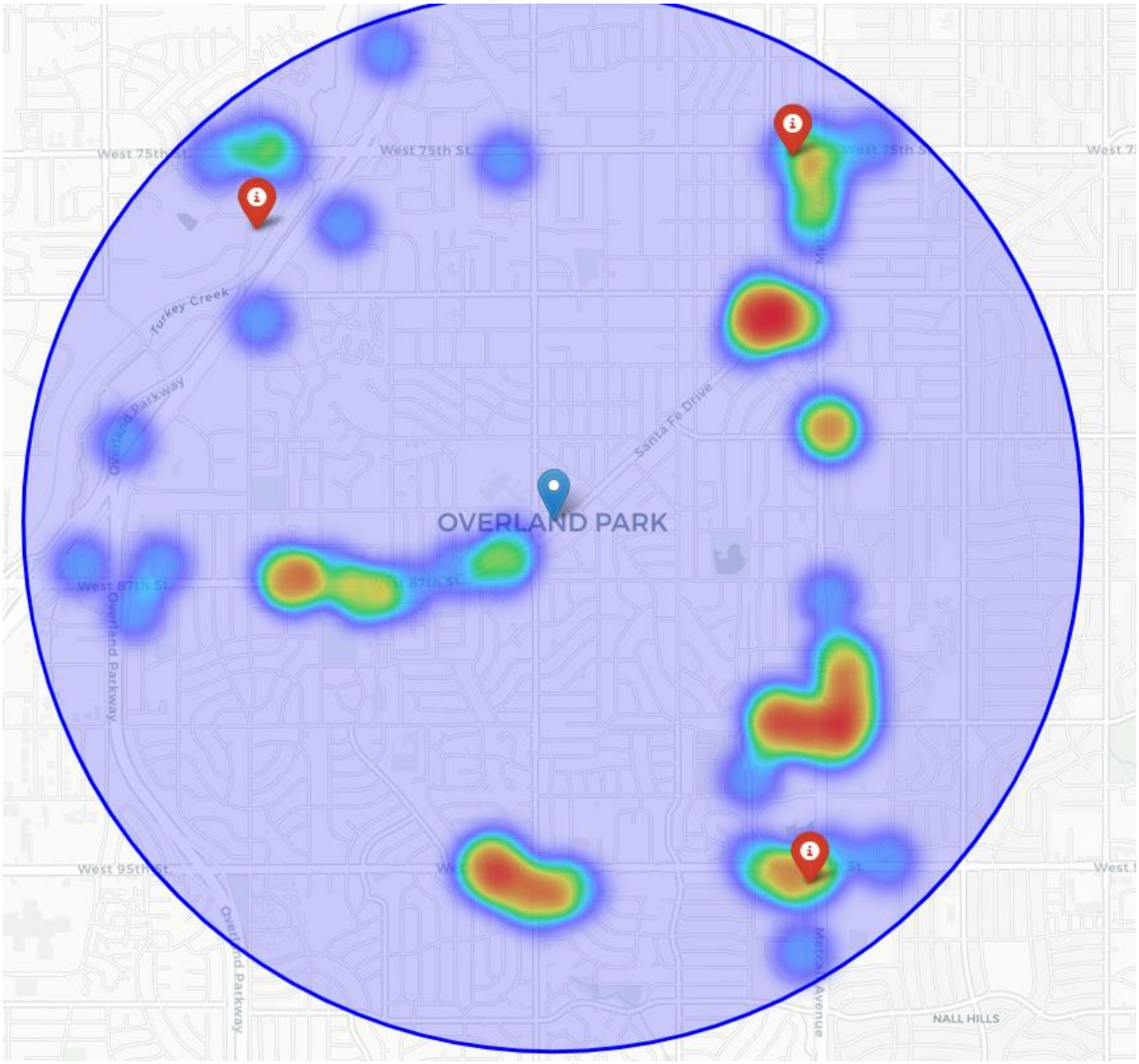
Using the weights of each concern above and the standardized data, we created a weighted score for each of the municipalities - the municipalities with the highest score let us know which municipalities would most likely benefit from another BBQ restaurant. The final transformed data as well as the weighted scores are given in the table below.

Name	BBQScaled	RestaurantScaled	PopulationScaled	Weighted Score
Overland Park Kansas	0.399530	-0.927524	0.981926	0.499783
Gardner Kansas	0.846064	1.768671	-0.599016	0.360293
Grandview Missouri	0.846064	1.182542	-0.565701	0.315006
Olathe Kansas	0.399530	-0.927524	0.480649	0.299272
Leawood Kansas	0.846064	0.244735	-0.477195	0.256627
Raymore Missouri	0.622797	1.768671	-0.602892	0.247109
Independence Missouri	0.399530	-0.849374	0.292775	0.231938
Leavenworth Kansas	0.622797	0.791789	-0.462745	0.205479
Liberty Missouri	0.622797	0.791789	-0.506560	0.187953
Lenexa Kansas	0.399530	0.752714	-0.301171	0.154568
Shawnee Kansas	0.176263	-0.185094	-0.189748	-0.006277
Gladstone Missouri	0.399530	-0.927524	-0.547245	-0.111885
Kansas City Missouri	-3.172740	-0.927524	3.755085	-0.177088
Belton Missouri	-0.270270	1.338843	-0.581343	-0.233788
Raytown Missouri	-0.047004	-0.185094	-0.527951	-0.253191
Lee's Summit Missouri	-0.493537	-0.927524	0.106299	-0.297002
Prarie Village, Kansas	-0.047004	-0.927524	-0.591703	-0.352935
Blue Springs Missouri	-0.493537	-0.927524	-0.288203	-0.454802
Kansas City Kansas	-2.056406	-0.927524	0.624737	-0.871061

Notice that the municipality with the highest weighted score is Overland Park, Kansas. We considered Overland Park more closely to determine if we could find exactly where in the city we might want to place a BBQ restaurant. The map below shows all of the different restaurants within Overland Park in green, with the BBQ restaurants highlighted in red.



We also can consider the map above as a heat map, with the BBQ restaurants still highlighted.



4. Results

Notice that in the heat map above, there is a BBQ restaurant within two of the more densely populated restaurant areas of Overland Park, and one in the Northwest corner as well in a lesser populated area of restaurants. We also see that there are not many restaurants in the Southwest corner of the map - this is a largely residential portion of the city, as can be checked with Google Maps streetviews.

Basing our decision on the criteria given above as well as the Foursquare restaurant location data, it seems that there one of the locations most likely to create a new and successful BBQ restaurant would be in Overland Park, likely along West 87th street, closer to the Western part of town than the East. We also saw that there are likely to be additional locations in Gardner, KS and Grandview, MO that we could find using a similar style of search. Should we decide to change the criteria or weights for

deciding which parts of town we would want to place a new BBQ restaurant, we also have enough data to make that decision, due to the collection and analysis of restaurants and BBQ restaurants in particular throughout the Kansas City Metropolitan area.

5. Discussion

It is worth noting that there are other criteria that are likely to be important to a new business owner that we have not discussed here - these things include real estate availability, land prices, taxes (in Missouri versus Kansas and also local taxes), and even more. We should also note the limitations of this project - there are portions of the Kansas City Metropolitan area that were not covered by any of our districts, and the Foursquare API limited the total number of restaurants returned for each one to 100. Notice that several of the districts met such a cap. In the future, it would be interesting to break the Kansas City area down into smaller districts, not limited to those with large name recognition, but instead to smaller areas that we can use to pull even more restaurant data. These smaller districts would likely provide a better coverage of the Kansas City area with less overlap. However, the challenge with doing so would be finding the appropriate population data. One option would be to remove this criterion completely, and change the way that we identify districts as good fits for a new BBQ restaurant.

6. Conclusion

In this project, we've explored possible locations for a new BBQ restaurant in the municipalities surrounding Kansas City, based on current density of restaurants, density of BBQ restaurants, and the population of the municipality. By using the restaurant location data from Foursquare, the predicted populations of each municipality, and a heat map within the specified municipality of interest, we were able to determine not only the best municipality for a new BBQ restaurant, but also potential locations within that municipality for the restuarant to be placed.

To make a final decision on where the restaurant would be placed, the business owners would likely want to visit the location in person to determine the physical features that cannot be determined strictly through data analysis - for instance, a location might great on paper, but upon visiting it could be clear that the restuarant isn't visible from nearby roadways. However, the analysis considered within this project provides a strong starting point for making the crucial decision of where to locate a new BBQ restaurant in Kansas City.